H04L 12/403

PCT WORLD INTELLECTUAL PROPERTY ORGANIZATION
International Bureau

INTERNATIONAL APPLICATION PUBLISHED UNDER THE PATENT COOPERATION TREATY (PCT)

(51) International Patent Classification 4 :		(11) International Publication Number:	WO 89/ 03145
H04L 11/16	A1	(43) International Publication Date:	6 April 1989 (06.04.89)

(21) International Application Number: PCT/GB88/00766

(22) International Filing Date: 16 September 1988 (16.09.88)

(31) Priority Application Number: 8722601

(32) Priority Date: 25 September 1987 (25.09.87)

(33) Priority Country: GB

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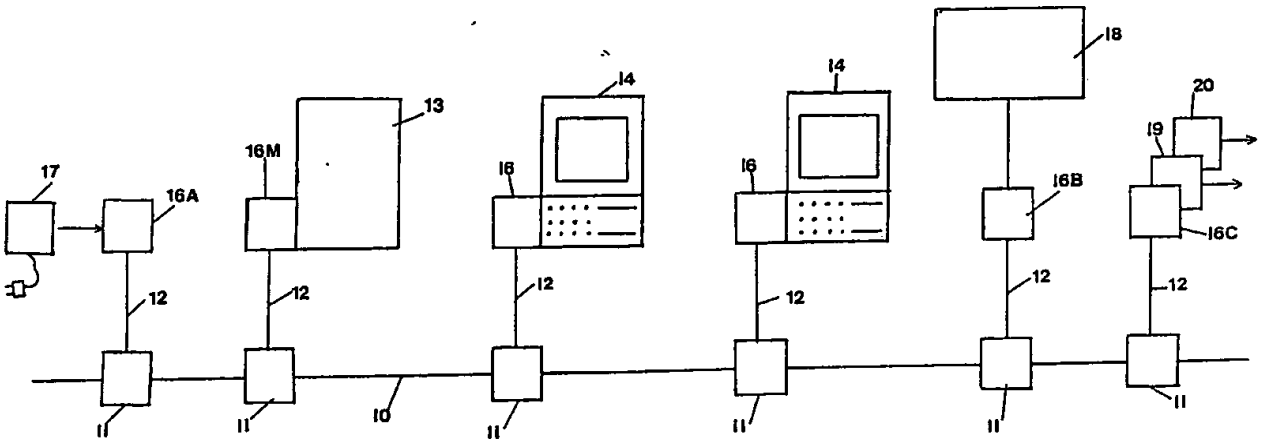
(81) Designated States: AT (European patent), BE (European patent), CH (European patent), DE (European patent), FR (European patent), GB (European patent), IT (European patent), JP, LU (European patent), NL (European patent), SE (European patent), US.

Published
With international search report.
Before the expiration of the time limit for amending the claims and to be republished in the event of the receipt of amendments.

(54) Title: NETWORK APPARATUS AND METHOD



(57) Abstract

A network for electronic components (for example computers, printers, modems) and a controller, therefore, connected to the network for controlling the network, controller being adapted so as in use to interrogate in turn components attached to the network, the controller being arranged so as to interrogate more frequently those components which it determines more frequently communicate with the network.

NETWORK APPARATUS AND METHOD

The present invention relates generally to a network and in particular to network apparatus comprising a network communications card or device providing a similar function, that is a means for communicating data in a network.

BACKGROUND OF THE INVENTION

It has become common for so-called work stations, or micro computers ie personal computers (PC's) hereafter referred to generally as work stations to be connected together, typically around an office or factory, by means of a network usually a Local Area Network (LAN). There are a number of different types of network system available, but in order to connect the work stations to the network, each work station usually requires the addition of a so-called network card. The network card comprises a printed circuit board on which are mounted various electronic components.

The network usually comprises a cable which interconnects the work stations. In one type of network the control of the network is in the hands of an (electronic) network controller, which may in practice be a master work station with a particular card attached to it.

Such a network arrangement has many advantages, enabling data to be transferred between different work stations, but there are still a number of problems to be overcome.

"Dumb" components such as printers, facsimile machines or modems which may connect the network to a telephone line cannot be attached to the network direct, but must be driven via a particular work station. This causes limitations in the convenience of use and application of the network.

There are other problems relating to networks and in particular the protocols used for driving the networks. The three main protocols for local area networks (LANS) are CSMA/CD, Token Ring, and Token Passing. With CSMA/CD, a work station can transmit directly onto the network providing that the line is quiet. Should two work stations start transmitting at the same time (which may happen when there are a large number of work stations in extensive use), then because of the corruption of the data, both will switch off and after a random time will return to the network. One of the two work stations will get back to the network first and then the second work station has to wait until the first work station is finished. On a mainframe or minicomputer network this solution is practical, as the activity is generally low and most packets of data get through first time. It often happens that while one station is transmitting, several others come along with data to communicate to the network. The end of the original transmission has the effect of synchronising the waiting work stations and so a collision is almost bound to result. The performance of the network therefore degrades as a function of the number of active work stations.

The token ring system provides a solution to this problem, by wiring all of the work stations in a

physical ring, a transmitter of one station to the receiver of the next and so on. The data moves around the ring and when a work station has data to pass it waits for a token marking a free space in the flow and inserts the data there. As the data passes through the destination work station it is either removed or marked as accepted so that the source station can remove it.

The Token Passing protocol network generally provides a network in which all of the network stations are connected to a bus structure. A token passes between the stations and only when a work station has received the token may it transmit and then it must pass the token onto the next work station in line.

Both of these token protocols avoid the problem of collisions at the expense of speed of point to point communication. On a busy network, however, this often results in a greater data throughput and also has the advantage that the maximum time and mean time for a message to get from one station to another are easily calculated. In the common token based protocols the token passes round all of the stations and so, on a fairly quiet network a good deal of time is wasted.

The above problems make the use of networks a good deal less flexible than they should be. Some of the above problems have been overcome by a networking arrangement in which there are provided nodes or terminals on the network which can be connected to a work station or to a printer direct, but in this instance the network itself runs at a very low rate (typically 1200 baud) with serial interfaces only and this makes interchange of data between the workstations extremely slow.

SUMMARY OF THE INVENTION

One aspect of the present invention, therefore, comprises a method and apparatus for reducing or overcoming the problems indicated above of the token protocols and the CSMA/CD protocols used with networks. The network may be in the form of a physical connection by, for example, cable, which may be a twisted pair of wires or coaxial cable, or optical fibre, or may be a non physical connection comprising, for example, a microwave, radio, infra-red or laser link

The present invention provides, according to a first aspect, apparatus for connecting an electronic component to a network, said apparatus including

first terminal means for connection to the electronic component,

second terminal means for connection to the network and

a microprocessor unit to operate independently of the electronic component to process data from the network and pass said data to the component and to process data from the component and pass said data to the network.

Such an apparatus may be used to connect "intelligent" components such as a work station (including PC's) to the network in the conventional manner, or may be used as an intelligent apparatus to connect "dumb" components such as printers or modems to the network. "Components" may also include scientific instruments, sensors, manufacturing equipment such as computer

controlled machine tools and robots, and audio and visual equipment.

In prior arrangements, where an intelligent terminal such as a PC is connected to a network, there has been provided a network card, but this network card is simply a "translator " allowing the intelligent terminal to speak to the network and vice versa and the card cannot operate independently, operating only under the control of the intelligent terminal.

Such an apparatus, as is clear, can be used to connect many pieces of equipment such as printers or modems to a network which have hitherto had to be connected to the network through a work station or have not hitherto been able to be connected to a network at all. This means that a printer or modem or any other component attached to the network may be accessed from any PC or work station or component on the network. Indeed, with the provision of the microprocessor unit, the apparatus itself may be used to carry out some computations either on its own or using other components (eg PC's) attached to the network or may control the network.

Also, the apparatus may be used to connect several communication cards to the network to drive, from a single apparatus of the invention, a plurality of dumb terminals or other components.

In addition to the microprocessor unit, the apparatus of the invention may include memory, and operation of the apparatus may be controlled by a programme in said memory, whereby operation of the apparatus can be changed by a change of the programme in the memory. In

a preferred aspect the programme in the memory can be changed via the network.

This provides the useful facility that the apparatus of the invention may be programmed and reprogrammed so as to act in different ways. For example, different printers require different protocols to operate them and so if the apparatus is connected to a printer, then when the printer is changed, the apparatus can be reprogrammed from any part of the network so as to operate the new printer (or other device).

Alternatively the apparatus may be reprogrammed to account for a wide variety of printer protocols and will "sense" any change of printer and automatically utilise the appropriate printer protocol to compensate for the change in printer. This increases the flexibility of the network considerably. The apparatus may similarly be preprogrammed or reprogrammed to operate with different work stations, modems, industrial and scientific equipment and the like. By such means the apparatus can function as a dedicated or non-dedicated multi-channel communication server, for example a printer server for multi-various printers, a tele-communication server, an industrial, laboratory or scientific process control server, either in a stand alone capacity or linked into a more extensive network.

The invention also provides, according to another aspect, a network and electronic components attached thereto, wherein at least one of said components has no processing power, the components being connected to the terminal by apparatus including first terminal means for connection to the relevant electronic component,

second terminal means for connection to the network and a microprocessor unit to operate independently of the electronic component to process data from the network and pass said data to the component and to process data from the component and pass said data to the network.

The invention also provides, according to a further aspect, a network and a controller connected to the network for controlling the network, the controller, in use, interrogating in turn components attached to the network, the controller being arranged so as to interrogate more frequently those components which it determines more frequently communicate with the network. Thus, the system allows the more frequently used components priority usage, and this priority can be changed dynamically to take into account changes in the usage of the components. In the course of this interrogation of every device on the network, the apparatus keeps a dynamically updated table of response and useage of the network by each attached component and gives priority use of the network to the more frequently used components, the priority given being in order of frequency of use.

In this way, the traffic on the network can be increased considerably by less frequently interrogating those components not in use or in use infrequently. For example, if a component has not been used for some time, and the other components are active, then the component might only be interrogated twice per second, whereas if the component is the only active component on the network then it might be interrogated, say, five hundred times per second.

Because every component on the network is interrogated, even if it is not in use, then the network may be used to provoke a reaction from the components being interrogated. In other words, Interrogation of a particular component may cause that component to pass onto the network information regarding, not only its status but also, for example, if the component is a measuring device, a signal representing the value of the parameter being measured at that particular time.

The present invention also provides a method for controlling a network comprising a network and electronic components attached thereto comprising interrogating the electronic components to determine the frequency which each component communicates with the network and, interrogating more frequently those components which it is determined more frequently communicate with the network.

DESCRIPTION OF PREFERRED EMBODIMENTS

A preferred embodiment of the invention will now be described by way of example only and with reference to the accompanying drawings in which:

Figure 1 shows in diagrammatic form a network incorporating the invention,

Figure 2 shows in diagrammatic form a network communications card incorporating the invention, and,

Figure 3 shows a block diagram of the operation of the network card of Figure 2,

Figure 4 shows in diagrammatic form, a card of Figure 2 connected to a plurality of "dumb" components, and,

Figure 5 shows a block diagram of the process relationships of the operation of the card of Figure 2.

Referring to Figure 1 there is shown a network which may be a bus-type network, a star-type network, a series of stars, or a mixed star-bus network. It comprises an electrical cable 10 which may be a coaxial cable (typically 75 ohm coaxial cable) or an unshielded twin solid conductor telephone cable. At various points as desired along the cable there are provided junction pieces 11 which in the case of coaxial cable will be T pieces and in the case of the telephone cable may be simple jack sockets. Spurs 12 from the junction pieces 11 run to each component to be connected to the network.

The components illustrated include a file server 13, and work stations 14 which may comprise personal computers.

As is generally well known, the file servers 13 and work stations 14 are each connected to the spurs 12 by means of a network communication card 16. Such cards are well known, but the cards 16 to be described comprises a preferred embodiment of the invention.

Thus far, the arrangement is generally conventional. However, in addition to the components thus far described, in the present instance, a network communications card 16 A, B, C according to the

invention may be connected by itself to the network by the spur 12 and junction piece 11. The network communications card 16A stands alone and hence requires a power supply indicated at 17. The network communications card 16B is connected to a dumb apparatus, in this case a printer 18 and the network communications card 16C is connected to two further cards 19,20 as will be described later.

Referring to Figure 2, there is illustrated in diagrammatic form a network communications card 16 according to the invention. The card comprises a printed circuit board 26 to which are attached various electronic components, some of which are illustrated in the Figure. Other conventional electronic components such as a clock, transformer and the like are not illustrated. The card 26 mounts a dual port random access memory (RAM) 27. The dual port RAM 27 is connected to a parallel interface 28 forming part of the card 26. The card also mounts a further random access memory (RAM) 28, a read only memory (ROM) 29, a central processor unit (CPU) in the form of a micro processor (CPU) 30, a communications chip (COMMS) 31, an RS 232 port 32, a coder chip 33 and a Local Area Network (LAN) connector 34. The various components are interconnected as illustrated in Figure 2, that is the dual port RAM 27, RAM 28, ROM 29, CPU 30 and COMMS 31 are all interconnected, the COMMS 31 is connected separately to the RS 232 port 32 and to the coder 33, and the coder 33 is connected to the LAN 34.

When the card 26 is attached to a host fileserver 13 or work station 14, it is connected by means of the parallel interface 28 to the fileserver or work

station, and the dual port RAM 27 then communicates directly with the memory within the fileserver or work station. This allows rapid communication between the card 26 and the host. One line on the interface 28 passes an interrupt signal to the host to cause the host fileserver or work station to interrogate the memory. It will be understood, therefore, that the card 26 and its host which may be the file server 13 or a work station 14 can communicate back and forth in a bidirectional manner.

The communications chip 31 is able to provide two input/output means via the RS 232 port 32 which operates at a lower rate, (typically 1200 baud) and via the coder chip 33 to the network 34 at a very much higher rate (typically 3 megabits/second). In fact data transfer on the network is typically 3 megabits/second a speed which is limited by factors other than the card 16. A higher speed is possible if these other limitations are removed.

Effectively, therefore, the card 26, by the inclusion of the CPU 30 is an intelligent card and by the use of the memory is able to store programmes to control its operation.

Thus, referring to Figure 1, the general principles of operation of the network will now be described. In general terms the fileserver 13 and work stations 14 operate with the network in a conventional manner. However, passage of information onto the network is controlled by a master card 16M in a unique manner. Each component attached to the network incorporates an address (preset by suitable switches, not shown, on

each card 16). Any one of the cards may be designated as the master card 16M and this controls the other cards and the network. The master card 16M is normally attached to the component of the network which is most in use and which will always be connected to a power supply when the network is in use. This master card 16M passes a "token" onto the network, the token carrying an address relating to one of the components attached to the network. When the component thus addressed receives the token, it is able to communicate with the network and pass information onto the network. Even if that information is not for the apparatus (in this case the fileserver 13) attached to the master card 16M, the master card 16M notes that information has been sent by the particular component. After the information has been received by the component to which it is directed, and after an acknowledgment has been sent if necessary, the master card 16M sends a token with a different address onto the network which enables another component to communicate with the network.

The master card 16M arranges to send the token to each component in turn. In practice the token may be sent to each component, therefore, at, typically, a rate of 500 times per second and so each component is able to communicate with the network 500 times per second.

On the other hand, if the master card 16M notes that a particular component has not communicated with the network for some time (which may be preset and may be typically a few minutes or may be inversely proportional to the overall network load), then it will no longer send the token to that component at the same rate, but at a reduced rate, typically once every half

second. Conversely, if the master card notes that certain components make greater use of the network than do others, then the token will be sent to them more frequently.

The master card 16M compiles a table of frequency of use for every attached component and the time interval since each attached component last communicated with the network. The master card varies the frequency of interrogation for each attached component according to a scale (which may be preset) and in proportion to the use of the network made by each component as is determined by the above dynamically updated log. The rate of interrogation for each attached component is reduced systematically in line with the increasing time interval since the component last communicated with the network; this rate is automatically increased to the maximum after the component has communicated once again and the process is repeated. For example the rate of interrogation may be reduced from the maximum 500 times per second, by say ten percent for every additional minute that the particular attached component fails to communicate with the network, the exact details can be preset.

In this way the traffic on the network can be suitably controlled, and the amount of time that the token is passed to a component which is not communicating or is infrequently communicating with the network is reduced thereby allowing efficient use of the network by giving priority to the most frequent users of the network.

The master card 16M can interrogate any component attached to the network in line with the above. It can

also restrict access to the network by interrogating selected components only at preset time intervals or at a preset time. It can simultaneously demand an anser or a "return" communication or that a preprogrammed activity be carried out, thereby acting as a remote triggering mechanism. By this means the master card 16M (and all other attached devices via the master card) can monitor and control any selected attached component. By this means, for example, a scientific instrument may be remotely triggered to carry out an analyses, at say two hourly intervals and the results can automatically be communicated to preselected components via the network.

It will be understood that if a component which has hitherto not communicated with the network for some time wishes to begin to communicate with the network, it would have to wait a maximum of about half a second before initially communicating with the network and thereafter, the master card 16M would note that it had communicated with the network and would pass the token to it at a more frequent rate. Thus, the only delay (which in any case is a maximum in this case of about half a second) occurs when the component first communicates with the network. Subsequent communications will be substantially without delay.

The above aspects of the invention, therefore, relate to the efficient use of the network via a new dynamic priority management protocol.

Because of the construction of the cards, they can be connected to the network alone. This is illustrated at 16A, 16B, 16C in Figure 1. Because they include a CPU

30 and memory, the cards in this case card 16B can be directly connected to a dumb terminal such as a printer 18 or a modem via, usually, the RS 232 port 32 (which operates at the correct baud rate). It is not necessary, therefore, in this case to connect a printer 18 or modem to an intelligent terminal such as a work station 14.

Furthermore, in the case of the card 16C, the card may be connected to conventional cards for operating eg: a modem 35, a printer 34, a display, a calculator, other network cards, a memory device, a disk or tape drive and indeed may be connected to more than one of them. In this case (see Figure 4), the card 16C is mounted in a simple box 36 having a socket 31A for receiving the interface 28, the socket being connected in parallel to a plurality of the other sockets 31B, C, in which the modem card 20 or printer card 19 may be connected, and these modem and printer cards can then operate modem 35 or printer 34 to which they may be attached, usually by an RS 232 port.

As is well known, different components such as printers, modems or work stations require a particular protocol for them to be operated and thus, the network communications cards of the invention allow communication between the component and the network and effectively change the protocol from one type to the other.

The CPU 30 of each card 26 operates under the control of a programme in the memory and an aspect of the present invention is that this programme can be changed.

Thus, for example, if the printer 18 is to be changed, then the programme in card 16B may be changed to suit the new printer and this can be done by passing the new programme from, for example, one of the work stations 14 through the network to the card 16B. This allows very great flexibility of the use of the network, because it means that, for example, the card 16B may be used as a simple output socket into which different printers 18 may be connected at will, the only requirement being that the programme stored in the card 16B must be changed so as to suit each printer or other component which is attached to that card 16B.

It will be understood that the hardware so far described is controlled by means of software to be described. Figures 3 and 5 show block diagrams indicating the operation of the software on each card 16.

Referring to Figure 5 there is shown the processing relationship between processing in the PC of a work station (process P0) which communicates across the interface 28 with a first process P1 carried out by the card 16 and a further process P2 carried out by the card 16. In order that the card 16 only needs one procesor, processes P1 and P2 are time duplexed, that is, they are not carried out at the same time, but the processor switches in a time share manner back and forth between the software processes P1 and P2 as set out in Figure 5. In other words, the hardware of Figure 2 sometimes carries out process P1 and sometimes process P2 under control of a time slicer shown in Figure 3. In an alternative arrangement, however, at

least two microprocessors may be provided on the card to carry out processes P1 and P2 respectively and simultaneously. Alternatively these two processors may be time sliced providing five processes in total. This, however, it not a limitation as many processors can be utilised to provide the equivalent amount of processes to communication interfaces on the card.

The output and input of process P1 is connected to the LAN interface 34 and the parallel interface 20 and P2 and the output and input of process P2 is connected to the RS 232 port 32. The two way flow of data between processes P0-P1, P1-34, P1-P2, P2-32, are illustrated in Figure 3.

It will also be understood that as described, the software processes P1,P2 may be carried out on the processor CPU 30 on the card 16 with memories 27,28,29, but also they may borrow processing capacity from the host micro computer, that is from P0 via the interface 28 by reason of being able to drive the host.

Referring to Figures 3 and 5 and in particular Figure 3 when the card is initially switched on (powered up) the initialiser sets the various circuits and the software into a ready state. The card 16 is then ready to receive data. There are a number of possibilities of operation of the card and we will set these out in series.

RECEIPT OF DATA FROM NETWORK

Consider first any card 16, 16A, 16B, 16C apart from the master card 16M. During initialisation the

processor unit instructs the COMMS chip 31 to pass any signal received from the network via LAN 34 into memory.

Thus, any message arriving on the network with a header carrying the address of the particular card in question will be passed by the LAN coder 33 and COMMS chip 31 directly into memory.

The central processor of the card is then polled to instruct the processor to examine the contents of the memory. In this case the CPU is acting as the data router shown in Figure 3. From the address or from the data in the packet of data which it finds in the memory, the CPU determines whether the data is to be passed through the PC interface into the PC to be processed by process PO, is to remain in the card to be processed by process P1, or is to remain in the card and be processed by process P2. If the message is to be passed to the PC, then the PC microprocessor is informed by means of an interrupt signal across interface 28. If the message is for process P1 (and this might, for example, be a new programme to reprogramme the card so as to operate with, for example, a different printer) then this reprogramming will be carried out by the CPU whilst operating under the action of the time slicer.

If the data is to be passed, for example, via process P2 to control eg: a printer, then the data is stored in memory until the CPU is called upon by the time slicer to carry out process P2, whereupon it acts on the data in that memory as necessary and passes it to the RS 232 port 32 for use by the printer or other component

attached.

Information to be Transmitted from the Card onto the Network

In this case, data which comes from the PC via the PC interface or from the printer or the modem attached to the RS 232 port 32 is prepared in to a form in which it can be transmitted via the LAN and is passed into memory. The COMMS chip 31 is set up ready to transmit. It is then necessary to wait for a signal to arrive on the LAN 34 from the master card 16M indicating that this particular card may communicate with the network (in other words, the receipt of a Token from the master card 16M). On receipt of this signal, the CPU will then operate to pass the data from the point in memory in which the data is stored onto the network via the COMMS chip 31.

It will be understood that in both of the above operations the data, once received and placed in memory is not in fact moved around from place to place, but the processor is sent the address of the data and when it requires to process the data is able to communicate with that address in the memory.

Master Card 16M

The master card operates in much the same way as described above. However, when it receives the data to be transmitted it can transmit immediately without waiting for the receipt of a token.

Furthermore, the master card, unlike the other cards, receives all of the data transmitted onto the network

so as to be able to determine the extent of usage of the network by a particular terminal.

In addition to the functions already referred to, the cards 16, because they have processing power of their own, can be used as stand alone computers. Thus, for example, if one of the work stations 14 wishes to carry out a calculation and there are some cards 16 not in use, then it can send portions of the calculation to a remote card 16 for the calculation to be carried out in that remote processor (or indeed, where the remote card 16 is connected to a processor not currently in use, eg a PC, then the PC processor may be used). In that way, the network may be used as a distributed processing computer to carry out parallel processing and this enables, much more complex calculations to be carried out by a work station attached to the present network than hitherto.

Thus, the invention provides a more flexible more efficient network for similar and dissimilar, intelligent and non-intelligent components, connected via physical and/or non physical communication media. which may be used to interlink, in an office environment, computers, personal computers, network stations, printers, modems, in a factory environment or chemical plant, computers, machine tools, robots, sensors, handling apparatus, motorised valves,printers, time clocks, and in a scientific laboratory, computers, scientific instruments, sensors. All of these components may be simply plugged into the network via a network card as described according to the invention and the network card may simply be reprogrammed to communicate in a proper fashion with the component

attached thereto. In this manner, for example, the local processing power in each component may be eliminated or reduced thereby leading to a saving in cost. Alternatively the local processing power may be put to greater use by being utilised for distributed parallel processing by other networked components.

As will be understood, the present invention addresses several aspects in relation to networking in its broadest interpretation, ie, it is not restricted to networking of personal or other computers or allied equipment and neither is it restricted to a physical or homogenous network communication media.

One aspect addresses the question of efficient data communication within a network. It comprises a method and apparatus for reducing or overcoming the problems of the token protocols and the CSMA/CD protocols used with conventional networks, thereby increasing the efficiency of data communication within a network; through the use of a new dynamically managed communication protocol.

Subsidiary benefits are automatically derived from the use of this new protocol, ,in that the utilization of the network by each attached component is dynamically logged and a utilisation table is continuously updated. This, data table, can provide management information and also be used to make greater useage of any networked device, through for example carrying out distributed parallel processing tasks on an intelligent component (or a card which is the subject of this invention) which is attached to the network and is found to be not in current use.

Another aspect addresses the limitations encountered in conventional networks in respect of the lack of connectability to a network of certain heterogeneous components and the possible use of multi-various communication media. Under the present invention the network may be in the form of a physical connection by, for example, cable, which may be a twisted pair of wires or coaxial cable, or optical fibre, or may be a non physical connection comprising, for example, a microwave or radio link or mixed.

Use of the invention can increase the utilisation of components and the apparatus itself. For example, the processing power of the said apparatus when not being used for communication or other purposes, (as can be verified remotely at any time by means of the interrogation process described above) can be used by any device on the network, thereby providing intelligence, additional intelligence and distributed parallel processing facilities.

Also, the apparatus is able to drive a host or any component attached to the network. Consequently a host or any such component can be accessed and activated to provide additional facilities for other attached devices and the said apparatus, for example, if the host or component is "intelligent" then use can also be made of its processor, thereby providing further intelligence and distributed parallel processing facilities to all devices on the network and to the apparatus.

Similarly, by means of the said apparatus any component

on a network can be interrogated (at will, randomly, at preset intervals or at fixed times) from any other component on the network and an action activated, for example, to close down a circuit, to open a valve, to take a sample, to print a readout, to activate an audio-visual recording, to display a message, or any such industrial or technical operations.

CLAIMS

1. A network and a controller connected to the network for controlling the network, the controller, including means to interrogate in turn components attached to the network, said interrogation means being arranged so as to interrogate more frequently those components which it determines more frequently communicate with the network.

2. A network and controller as claimed in claim 1 in which said interrogation means compiles a table of frequency of use for every component and the time interval since each component last communicated with the network.

3. A network and controller as claimed in claim 1 or 2 in which said interrogation means interrogates the components which least frequently communicate with the network at a predetermined minimum frequency.

4. A network and controller as claimed in any of claims 1 to 3 in which the network is a bus-type network.

5. A network and controller as claimed in any of claims 1 to 4 in which the network includes a star-type network.

6. A network and a controller as claimed in any of claims 1 to 7 in which said components are each connected to said network by respective connector means comprising first terminal means for connection to the electronic component, second terminal means for connection to the network, and a microprocessor unit to

operate independently of the electronic component to process data from the network and pass the data to the component and to process data from the component and pass said data to the network.

7. A network and controller as claimed in claim 6 in which one of the connector means comprises said controller.

8. A network and controller as claimed in claim 6 or 7 in which each of said connector means can be arranged to receive data from the network, process said data, and return said processed data to the network without communicating said data to its component.

9. A network and controller as claimed in claim 8 in which said connector means processing data from the network also utilises a microprocessor or memory in the component to which it is connected.

10. A network and controller as claimed in any of claims 6 to 9 in which each of said connector means can be arranged to receive data from the component to which it is attached, process said data, and return said processed data to said component without communication with said network.

11. A network and controller as claimed in any of claims 6 to 10 in which each connector means includes memory means including a programme to control its microprocessor.

12. A network and controller as claimed in claim 11 in which each connector means includes means to change

the programme in the memory by data received from the network.

13. A method for controlling a network comprising a network and electronic components attached thereto comprising interrogating the electronic components to determine the frequency which each component communicates with the network and, interrogating more frequently those components which it is determined more frequently communicate with the network.

14. Apparatus for connecting an electronic component to a network, said apparatus including

first terminal means for connection to the electronic component,

second terminal means for connection to the network and

a microprocessor unit to operate independently of the electronic component to process data from the network and pass said data to the component and to process data from the component and pass said data to the network.

15. Apparatus as claimed in claim 14 including memory means whereby the memory means may include a programme for controlling the microprocessor.

16. Apparatus as claimed in claim 15 in which means is provided to change the programme in the memory via the network.

17. Apparatus as claimed in any of claims 14 to 16 in which there are provided at least one more terminal

means.

18. Apparatus as claimed in any of claims 14 to 17 in which said apparatus can be arranged to receive data from the network via the second terminal means, process said data, and return said processed data to the network via the second terminal means without communicating said data to its component, via said first terminal.

19. Apparatus as claimed in claim 18 in which said apparatus processing data from the network also utilises a microprocessor or memory in the component to which it is connected.

20. A network and electronic components attached thereto, wherein at least one of said components has no processing power, the components being connected to the terminal by apparatus as claimed in any of claims 14 to 19.

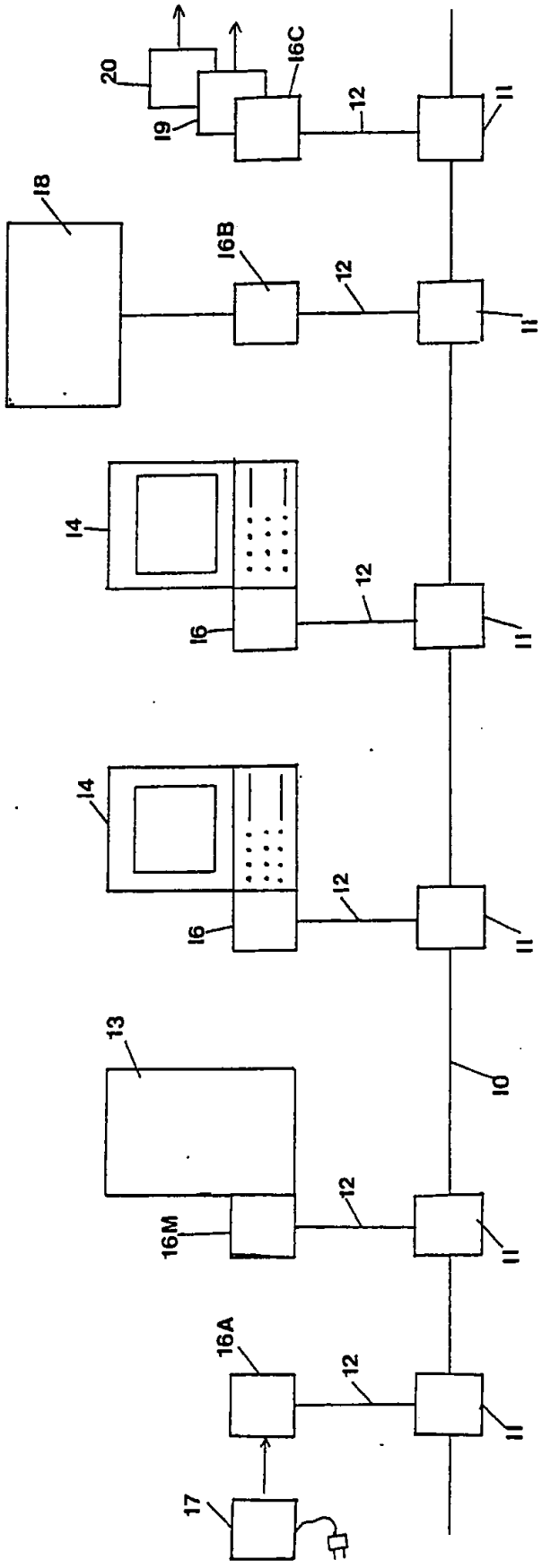

20
19
16C
12
11
18
16B
12
11
14
16
12
11
14
16
12
11
13
16M
12
11
10
16A
12
11
17

FIG 1

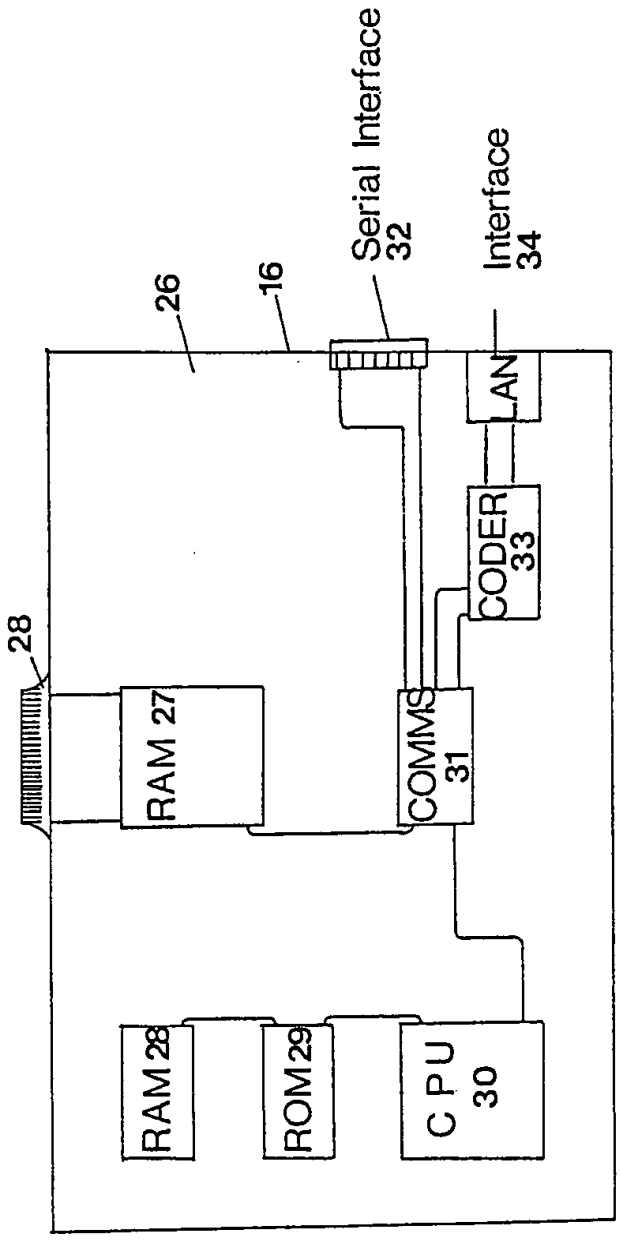

Serial Interface
32
Interface
34
26
16
LAN
CODER
33
28
RAM 27
COMMS
31
RAM 28
ROM 29
C P U
30

FIG 2

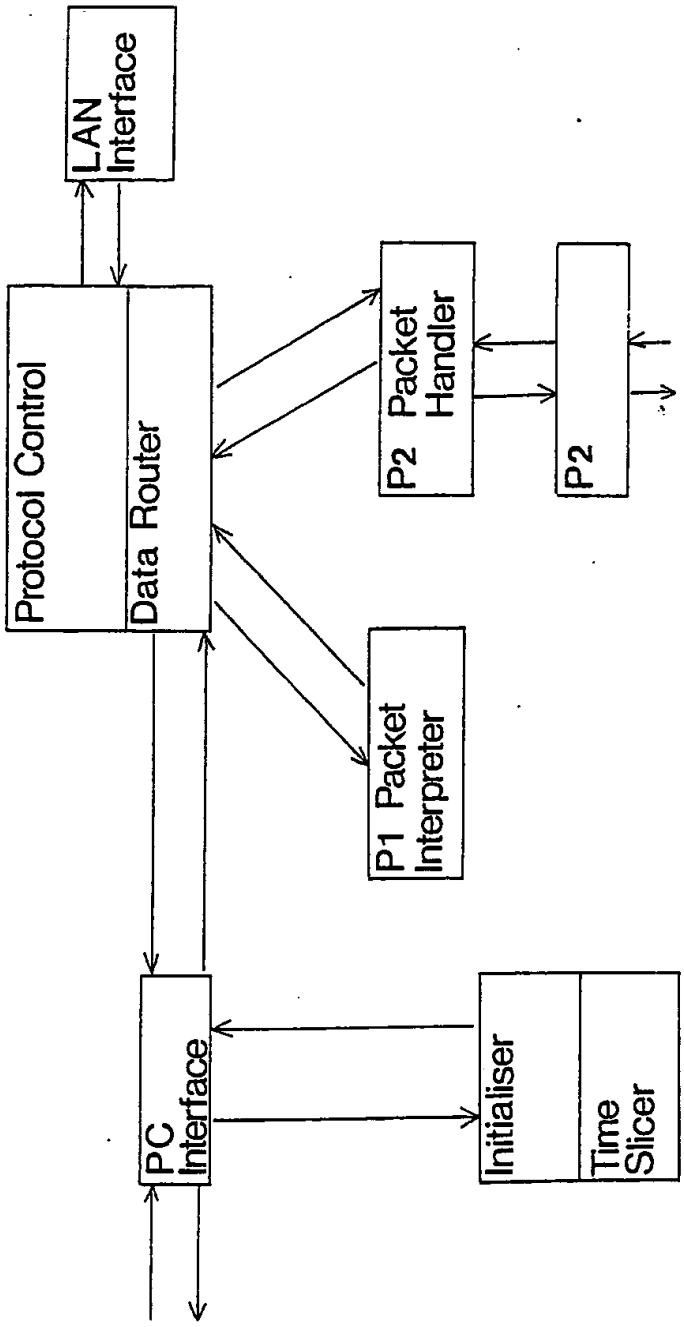

LAN Interface
Protocol Control
Data Router
P2 Packet Handler
P2
P1 Packet Interpreter
PC Interface
Initialiser
Time Slicer

FIG 3

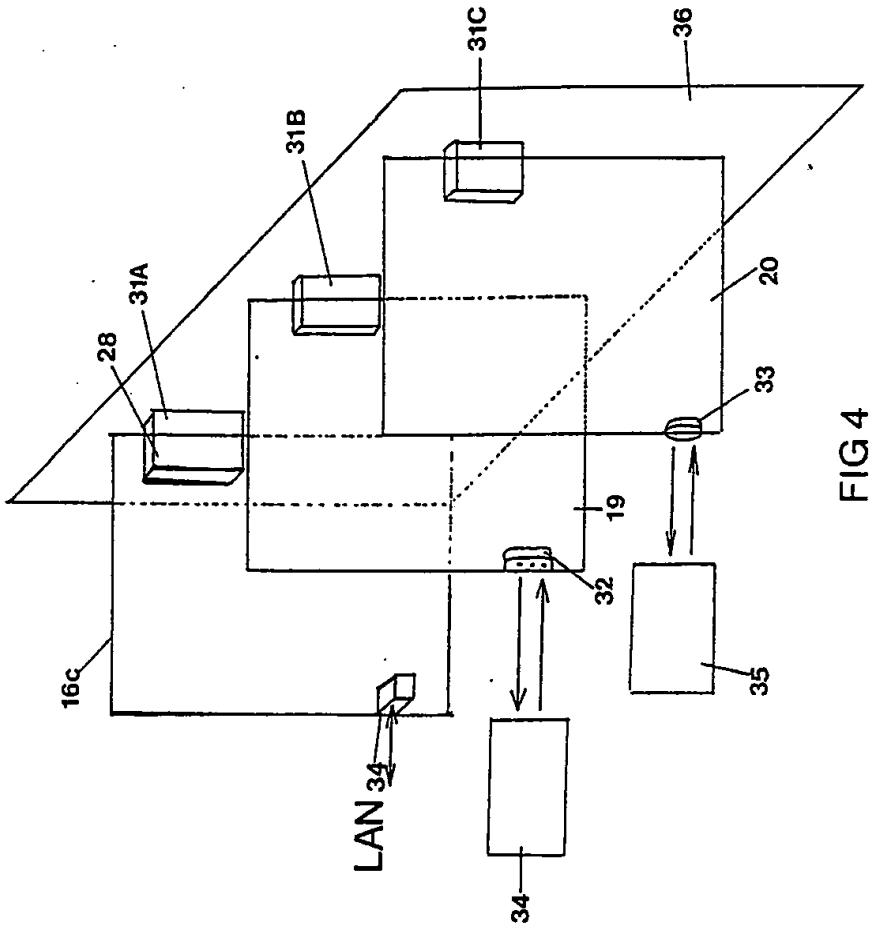


FIG 4

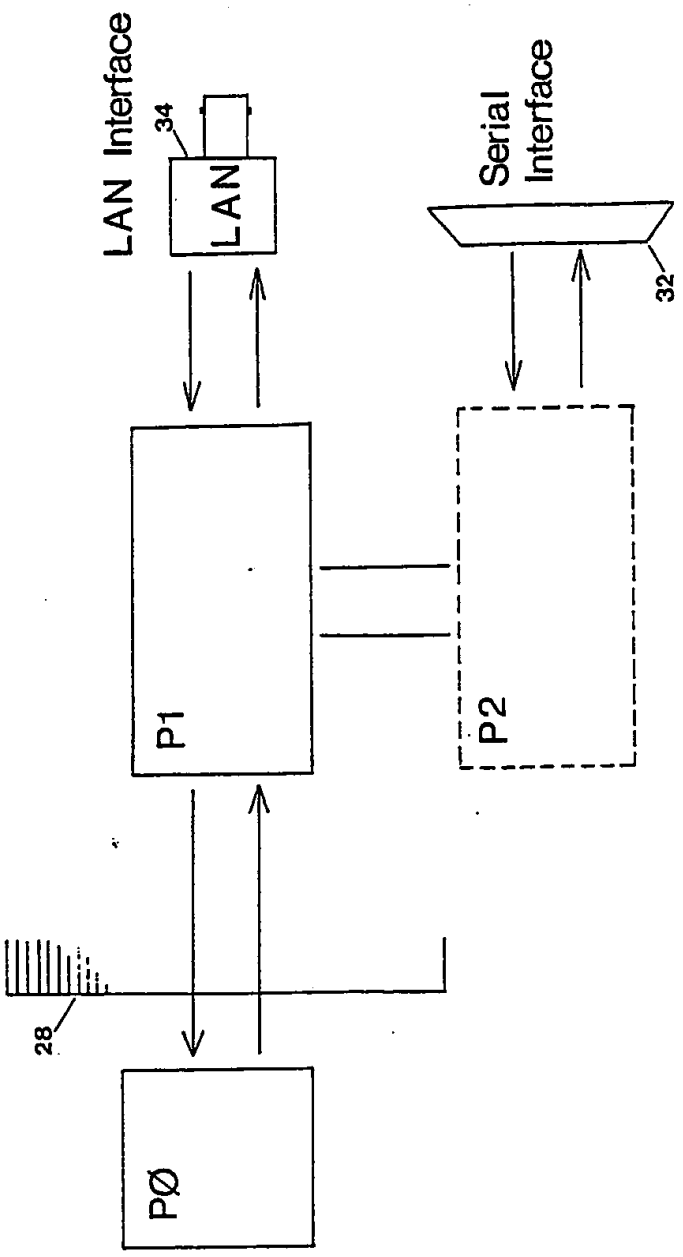


FIG 5

INTERNATIONAL SEARCH REPORT

International Application No PCT/GB 88/00766

I. CLASSIFICATION OF SUBJECT MATTER (if several classification symbols apply, indicate all) [5]

According to International Patent Classification (IPC) or to both National Classification and IPC

IPC[4]: H 04 L 11/16

II. FIELDS SEARCHED

Minimum Documentation Searched [7]

Classification System	Classification Symbols
IPC[4]	H 04 L

Documentation Searched other than Minimum Documentation to the Extent that such Documents are Included in the Fields Searched [8]

III. DOCUMENTS CONSIDERED TO BE RELEVANT [9]

Category [10]	Citation of Document, [11] with indication, where appropriate, of the relevant passages [12]	Relevant to Claim No. [13]
X	IBM Technical Disclosure Bulletin, volume 14, no. 10, March 1972, (New York, US), J.N. Beard et al.: "Dynamic priority polling", page 3091 see the whole document	1-5,13
X	FR, A, 2406916 (IBM) 18 May 1979 see page 2, lines 13-32; page 5, lines 21-36; page 14, lines 7-11; claim 10	1,13
A		2-5

* Special categories of cited documents: [10]

"A" document defining the general state of the art which is not considered to be of particular relevance

"E" earlier document but published on or after the international filing date

"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)

"O" document referring to an oral disclosure, use, exhibition or other means

"P" document published prior to the international filing date but later than the priority date claimed

"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention

"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step

"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art.

"&" document member of the same patent family

IV. CERTIFICATION

Date of the Actual Completion of the International Search	Date of Mailing of this International Search Report
10th November 1988	26 JAN 1989
International Searching Authority	**Signature of Authorized Officer**
EUROPEAN PATENT OFFICE	P.C.G. VAN DER PUTTEN

FURTHER INFORMATION CONTINUED FROM THE SECOND SHEET

V. ☐ OBSERVATIONS WHERE CERTAIN CLAIMS WERE FOUND UNSEARCHABLE [1]

This international search report has not been established in respect of certain claims under Article 17(2) (a) for the following reasons:

1. ☐ Claim numbers ..... because they relate to subject matter not required to be searched by this Authority, namely:

2. ☐ Claim numbers ..... because they relate to parts of the international application that do not comply with the prescribed requirements to such an extent that no meaningful international search can be carried out, specifically:

3. ☐ Claim numbers ..... because they are dependent claims and are not drafted in accordance with the second and third sentences of PCT Rule 6.4(a).

VI. ☒ OBSERVATIONS WHERE UNITY OF INVENTION IS LACKING [2]

This International Searching Authority found multiple inventions in this international application as follows:

1. Claims 1-5, 13: A network and a controller connected to the network for controlling the network.
2. Claims 6-12, 14-20: Apparatus for connecting an electronic component to a network.

1. ☐ As all required additional search fees were timely paid by the applicant, this international search report covers all searchable claims of the international application.

2. ☐ As only some of the required additional search fees were timely paid by the applicant, this international search report covers only those claims of the international application for which fees were paid, specifically claims:

3. ☒ No required additional search fees were timely paid by the applicant. Consequently, this international search report is restricted to the invention first mentioned in the claims; it is covered by claim numbers:

Claims 1-5, 13

4. ☐ As all searchable claims could be searched without effort justifying an additional fee, the International Searching Authority did not invite payment of any additional fee.

Remark on Protest

☐ The additional search fees were accompanied by applicant's protest.

☐ No protest accompanied the payment of additional search fees.

ANNEX TO THE INTERNATIONAL SEARCH REPORT ON INTERNATIONAL PATENT APPLICATION NO. GB 8800766 SA 24328

This annex lists the patent family members relating to the patent documents cited in the above-mentioned international search report. The members are as contained in the European Patent Office EDP file on 16/01/89
The European Patent Office is in no way liable for these particulars which are merely given for the purpose of information.

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
FR-A- 2406916	18-05-79	DE-A- 2844058	26-04-79
		JP-A- 54062707	21-05-79
		US-A- 4227178	07-10-80
		GB-A- 1596058	19-08-81